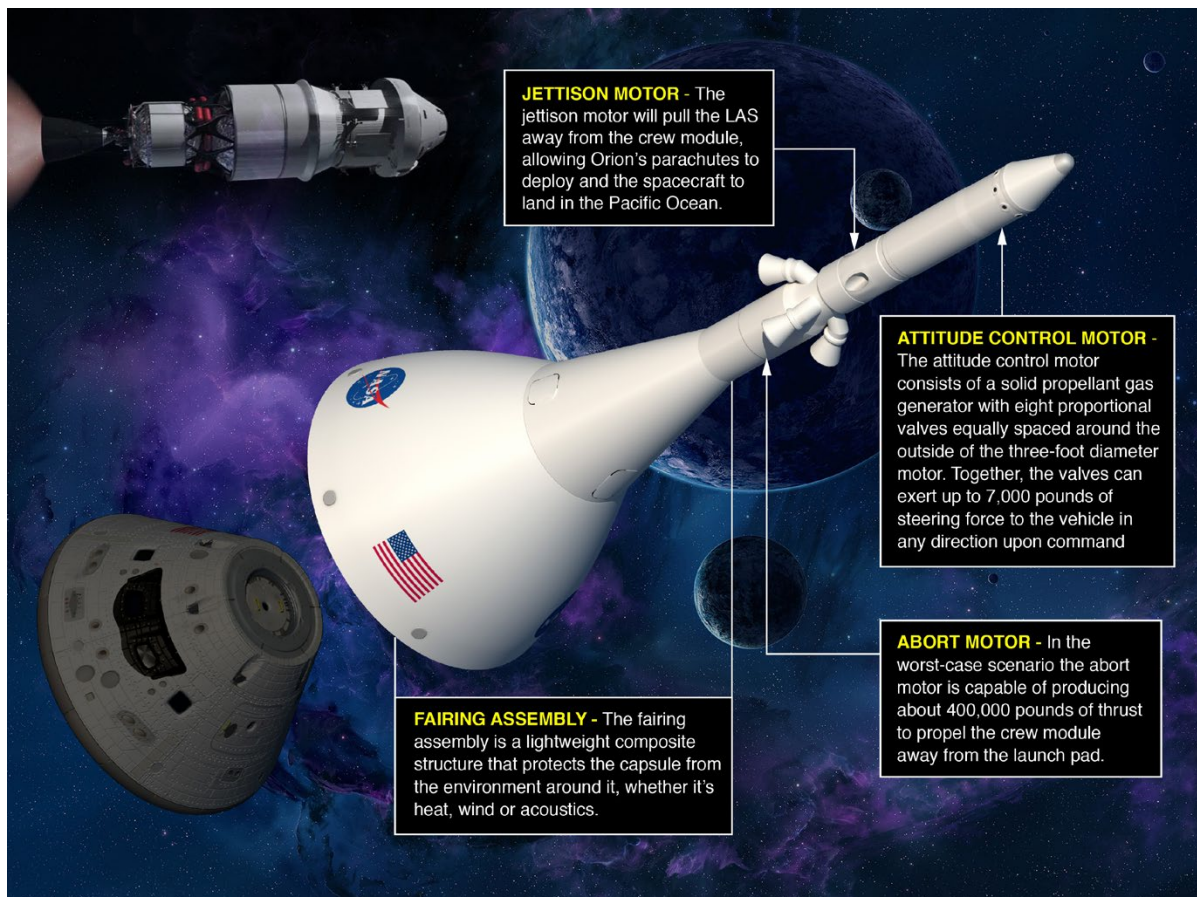


Human Spaceflight

NASA Langley Research Center Flight Projects Directorate Office
Orion Launch Abort System (LAS) *Ensuring Astronaut Safety*

NASA is developing technologies that will enable humans to explore new destinations in the solar system. America will use the Orion spacecraft, launched atop the Space Launch System rocket, to send a new generation of astronauts beyond low-Earth orbit to places like an asteroid and eventually Mars. To keep astronauts safe in such difficult yet exciting missions, NASA and Lockheed Martin collaborated to design and build the Launch Abort System.

The Launch Abort System, or LAS, is positioned atop the Orion crew module. It is designed to protect astronauts if a problem arises during launch by pulling the spacecraft away from a failing rocket. Weighing approximately 16,000 pounds, the LAS can activate within milliseconds to pull the vehicle to safety and position the module for a safe landing. The LAS comprises three solid propellant rocket motors—the abort motor, an



In the event of an emergency on the launch pad or during ascent, a launch escape system called the Launch Abort System (LAS) will separate the Crew Module from the launch vehicle using a solid rocket-powered launch abort motor (AM).

attitude control motor, and a jettison motor— that produce the same power as five and a half F-22 Raptors combined.

NASA's Pad Abort-1 flight test was the first fully integrated test of the LAS, which successfully launched May 6, 2010, at the U.S. Army's White Sands Missile Range near Las Cruces, New Mexico. The flight was the first in a series of in-flight demonstrations of the three solid rocket motors and parachute landing system. The test was part of an ongoing mission to develop safer vehicles for human spaceflight applications.

In 2014, NASA launched the Orion spacecraft for the first time on Exploration Flight Test-1 (EFT-1), a mission that took Orion farther into space than any spacecraft built for humans has gone in more than 40 years. Because EFT-1 was uncrewed, only the jettison motor was active on the LAS, but the successful jettison of the system was critical to the mission's success. The flight test provided information on the abort system's performance during the spacecraft's trip to space.



Pictured above is the LAS that launched atop the Orion Multi-purpose Crew Vehicle during Exploration Flight Test 1. The LAS was integrated with the spacecraft at the Launch Abort System Facility at Kennedy Space Center prior to the flight test in 2014.

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These data have allowed engineers to identify risks associated with deep space flight and reentry and use that knowledge to improve the design of Orion for its next test flights, Exploration Missions 1 and 2 (EM-1 and EM-2). Performance data have helped to improve manufacturing processes, as well. Engineers have already incorporated many of these improvements into elements of the EM-1 design, including the crew compartment (or pressure vessel) planned for launch during EM-1.

EM-1 will be the first integrated flight test of the world's most powerful rocket, the Space Launch System (SLS). During this test, SLS will launch an uncrewed Orion spacecraft to demonstrate the integrated system performance of the rocket and spacecraft before a crewed flight. The jettison motor will be the only active motor on the LAS.

The final launch abort system test, Ascent Abort-2 or AA-2, will launch an Orion mockup from Space Launch Complex 46 in Cape Canaveral, Florida. During the test, the spacecraft will be integrated with an ascent test booster—a first-stage booster from a Peacekeeper missile modified by Orbital Alliant Techsystems. AA-2 will test the LAS and its three motors. Reaching speeds up to 600 mph, the LAS will demonstrate a successful abort under the highest aerodynamic loads it will experience in flight. Aerodynamic forces build as the booster accelerates through the atmosphere, reaching a maximum when the vehicle reaches speeds up to Mach 1. Then the LAS will ignite, pulling the crew module away from the ascent test booster. All three motors will be active, proving the LAS's readiness for human flight. This test also will assess the capabilities of numerous flight vehicle components.

EM-2's launch is planned for the early 2020s and will be Orion's first crewed flight, taking astronauts beyond low-Earth orbit for the first time since Apollo 17 in December 1972. EM-2 will build on results of the EM-1 flight with additional requirements that the Orion capsule includes fully integrated environmental control and life support systems; controls; communications designed specifically for the human operation; and advanced launch and reentry space-suits for the crew. All three motors will be active on the LAS in the unlikely event of an emergency.

The Flight Projects Directorate (FPD) at NASA's Langley Research Center successfully completes flight projects from concept definition through launch. FPD drives new business, develops strong teams through effective partnerships, and improves processes and procedures. FPD projects support the Aeronautics, Space Technology, Science, and Human Exploration Mission Directorates.

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